

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

**EP 0 827 287 A2**

(12)

**EUROPEAN PATENT APPLICATION**

(43) Date of publication:  
**04.03.1998 Bulletin 1998/10**

(51) Int Cl.<sup>6</sup>: **H04B 7/005**, H04B 7/26,  
H04B 17/00

(21) Application number: **97660093.2**

(22) Date of filing: **27.08.1997**

(84) Designated Contracting States:  
**AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC  
NL PT SE**

- **Santomaa, Veli**  
**02200 Espoo (FI)**
- **Kivelä, Seppo**  
**24240 Salo (FI)**

(30) Priority: **30.08.1996 FI 963389**

(71) Applicant: **NOKIA MOBILE PHONES LTD.**  
**02150 Espoo (FI)**

(74) Representative: **Levlin, Jan Markus**  
**Berggren Oy Ab**  
**P.O. Box 16**  
**00101 Helsinki (FI)**

(72) Inventors:  
• **Myllymäki, Kimmo**  
**02130 Espoo (FI)**

**(54) Alarming system for a handheld telephone**

(57) The invention relates to portable mobile communication means, in particular to the ways and situations in which they are used. The system according to the invention measures the power transmitted by the mobile communication means and the reflected power returning from the antenna. From these the system calculates various parameters, for example the short-term average value, the cumulative sum of transmitted power used during a call and the proportion of power reflected

back. The user may set the limit values which he requires for these parameters, and the system will issue an alarm when these are exceeded. If the user so desires, the system may also continuously display the value of a desired quantity. With the aid of the system according to this invention, the user may monitor the benefit of different positions and ways in which the appliance is used and the power consumption of the mobile communication means in different situations, and thus avoid unfavourable operating situations and methods.

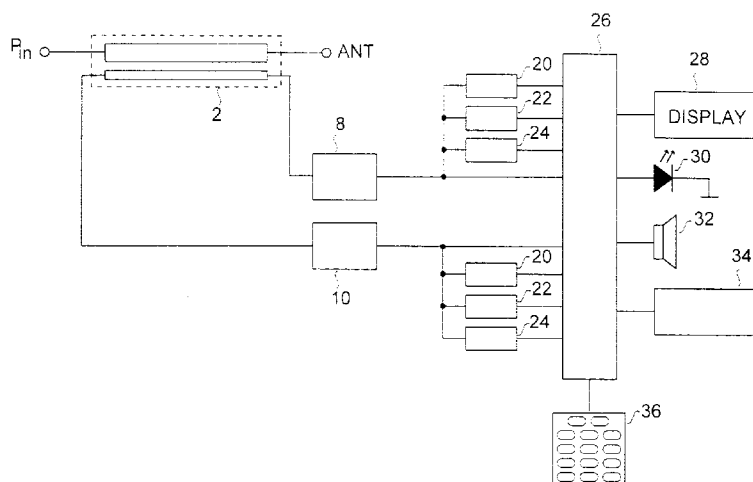


Fig. 3

## Description

This invention relates to mobile means of communication, and in particular to the ways and situations in which they are used.

In the most common mobile communication means systems, the base station controls the transmitted power of the mobile communication means on the basis of the received signal level. The transmitted power of a mobile communication means close to the base station is small, whereas at the limits of the coverage area the transmitted power is at its maximum. The current consumption of a mobile communication means is thus highly dependent upon the place in which the device is used.

Different obstacles, particularly in the immediate vicinity of the antenna, also attenuate the transmitter signal. The base station compensates for this attenuation by increasing the transmitted power of the mobile communication means. For example, a poor operating position of the mobile communication means, or having the antenna too close to the user's head, may cause an unnecessary rise in the current consumption. The same problem also arises when the user has turned so that his head lies between the base station and the mobile communication means.

A third factor affecting the intensity of the signal received by the base station is the position of the antenna of the mobile communication means. The base station antennae are typically arranged so as to transmit and receive vertically polarized signals, in which case the signal received by the base station is at its most powerful when the antenna of the mobile communication means is in the vertical position. If the user holds the mobile communication means diagonally or even horizontally, the signal received by the base station is thereby weakened, in which case the base station has again to increase the transmitted power.

An object of this invention is to create a system which directs the user of a mobile communication means to use his device in an optimal way. An object of this invention is also to create a system with the aid of which the user may avoid or shorten the length of a call when the power consumption of the mobile communication means is high. A further object of the invention is to create a system with the aid of which the user may maximize the battery charging interval. An object of the invention is also to create such a system with as little alteration as possible to current mobile telephones.

The objects of the invention are attained by monitoring the power fed to the antenna and the reflected power returning from the antenna, and by informing the user of these in the way desired by the user. The amount of power fed to the antenna immediately reveals the level of current consumption by the mobile communication means. Objects close to the antenna cause reflection of power back, in which case a high level of reflected power indicates that the antenna is, for example, too close to

the user's head.

This invention is characterized by the fact that it comprises

- 5 - a detector of power fed to the antenna,
- a detector of reflected power returning from the antenna,
- a control device,
- at least one alarm device and by the fact that the system is designed to monitor
- 10 - reflected radio power returning from the mobile communication means antenna power fed to the mobile communication means antenna, and
- reflected radio power returning from the mobile communication means antenna, and by the fact that the system is designed to alarm the user of the mobile communication means of a manner of usage in which the radio power consumption of the mobile communication means exceeds a preset limit.

The system according to this invention measures the power transmitted by the mobile communication means and the reflected power returning from the antenna as a function of time. From these the system calculates different parameters, for example the short-term average value, the cumulative sum of transmitted power used during a call and the ratio of transmitted to reflected power. The user may determine his desired limit values for these, and when these limit values are exceeded the system will issue an alarm concerning this. If the user so desires, the system may also continuously indicate the value of a desired quantity. With the aid of the system according to this invention, the user may monitor the suitability of different positions and modes of use and the power consumption of the mobile communication means in different situations, and thus avoid unfavourable situations and modes of use.

Below, the invention will be described in greater detail with reference to favourable embodiments, which are presented by way of example, and to the attached drawings, where

- Figure 1 shows a system according to the prior art for measuring the power fed to an antenna and the reflected power returning therefrom,
- Figure 2 shows the circuitry of a detector according to the prior art for power coming from a directional coupler, and
- 50 Figure 3 shows an example of a system according to the present invention.

In the drawings, the same reference numbers and symbols are used for parts which correspond to one another.

Figure 1 shows a system according to the prior art for measurement of the outgoing and reflected power, which may advantageously also be used in the system

according to this invention. The directional coupler 2 is situated in the transmission line between the output stage of the transmitter and the antenna. The directional coupler comprises, in addition to the transmission line connectors, two outputs, the signal level of the first of which is proportional to the signal power going to the antenna from the output stage, and the signal level of the second of which is proportional to the signal power going from the antenna to the output stage. These outputs are connected to detectors 8, 10 at the outputs of which there is a DC voltage  $U_{ant}$  proportional to the power going to the antenna and a DC voltage  $U_{ref}$  proportional to the power going to the output stage. Figure 2 shows the circuitry of a detector 8, 10 according to the prior art which is suitable for the system according to this invention. The operation of this detector is described in greater detail in the Finnish Patent 82865 and in the corresponding US Patent 5 214 372. In the system according to the present invention use may also be made of any other measuring- and detection circuitry according to the prior art.

In mobile means of communication according to the prior art it is typically only the transmitted power which is measured for regulation of the power output, in which case detector 10 in the measuring circuit according to Figure 1 is usually replaced by a resistor. In the system according to the present invention it is essentially the power in both directions which is measured.

Figure 3 shows one embodiment of the system according to the present invention. The outputs of the detectors 8, 10 in the system according to this invention are connected to a control circuit 26, which may for convenience be the micro-processor 26 controlling the operation of the mobile communication means. The system may also include signal processing devices, which calculate various parameters on the basis of the output signals of the detectors, such as, for example, the short-term average value, the cumulative sum of transmitted power used during a call and the ratio of transmitted to reflected power. These signal processing devices may conveniently be realized as programmes of the control circuit 26. The control circuit 26 monitors the transmitted and the reflected power and the parameters calculated from these by the signal processing devices 20, 22, 24. Control circuit 26 may transmit to the user information as to the values of these quantities or as to whether the set limits are exceeded, for example with the aid of the display 28, a light-emitting diode 30, a loudspeaker or similar device 32 or a vibrator 34. The user may set the limits he requires for different quantities, for example with the aid of the keypad 36 of the mobile communication means.

In another favourable embodiment of this invention the signal processing devices 20, 22, 24 are realized programmatically as a programme of the microprocessor 26. In that case, the output signal of detectors 8, 10 has to be converted to digital form with an analog/digital converter, after which the processor 26 may carry out

the necessary signal processing operations.

The system according to this invention may transmit information as to the value of the quantities and as to whether limits are exceeded, for example by a visual signal, an acoustic signal or a mechanical signal. The visual signal may for example take the form of a light-emitting diode 30 or a symbol shown on the display 28 of the mobile communication means, which the system illuminates when a specific limit is exceeded.

With the aid of the display 28 it is possible to produce a wide selection of different indications; the indicator may for example be a symbol, text or the numerical value of a particular quantity.

With the mobile communication means loudspeaker 32, earpiece 32 or corresponding device it is possible to create various acoustic signals. When the limit value of a given quantity is exceeded, the system may issue an acoustic signal, or the value of a desired quantity may be transmitted to the user as a quiet acoustic signal, the frequency of which is dependent upon the value of the quantity. Such a signal should ideally be so quiet that it does not disturb the user's call, in which case the user may, by monitoring the pitch of the signal tone during the call, find a more favourable call location or a better operating position. The vibratory alarm of the mobile communication means may also act as the alarming device in the system according to this invention.

With the system according to this invention it is possible to monitor a wide selection of quantities in addition to directly measured transmitted and reflected power.

The short-term average value is in many cases a quantity more useful than the measured instantaneous power, since rapid changes in power caused by momentary variations in signal strength occurring, for example, when the user is moving, do not in that case immediately result in an alarm. Another useful monitored quantity is the cumulative sum of power used during a call, with the aid of which the user may set for each call the upper limit of used power which he desires. In this way the user may be warned of situations in which the battery of the mobile communication means discharges rapidly.

In many situations, the ratio of transmitted to reflected power is a quantity more useful than reflected power alone, since the amount of transmitted power directly affects the reflected power. The power ratio best describes the condition of the antenna and the effect of objects close to the antenna on the signal. As the proportion of reflected power increases, the system may issue an alarm indicating that an object is too close to the antenna.

The quantity of reflected power alone is a useful monitored quantity if the user desires to reduce to a minimum the SAR value or the quantity of radio-frequency radiation directed at his body, as the amount of power reflected from the body is dependent upon the same factors as the quantity of radiation directed at the body: the transmitted power and the distance of the antenna from the body. For monitoring of the quantity of radio-frequen-

cy radiation directed at the body, the system may also incorporate a proximity sensor to measure the distance between the mobile communication means antenna and the body of the user. In a favourable embodiment of the invention the system may automatically reduce the outgoing power or interrupt transmission, if the quantity of reflected power exceeds a desired limit value, in which case the user does not need to monitor the system's indications.

A third useful calculated quantity is the peak value of power or of some other above-mentioned quantity which has occurred during a specific period of time, since with the customary models of mobile communication means the user does not look at the display of the mobile communication means during a call. With the aid of such a peak value quantity the user may however monitor power peaks occurring during a call.

In the system according to this invention, the user may adjust the alarming limits and types of alarm in various ways advantageously with the aid of the keypad 36 and display 28 of the mobile communication means. The user may select the quantities which he desires, set the alarming limits which he desires and choose the type of alarm which he requires. For example, the user may choose to have the short-term average value of transmitted power continuously visible on the display of the mobile communication means, and set an alarming limit on reflected power, and choose the type of alarm as a quiet acoustic signal which does not disturb his call. The user may also, if he so desires, prevent the issuing of all alarms.

With the aid of the system according to the invention, the user may control the power consumption of the mobile communication means. This is particularly useful in circumstances in which the user does not have the opportunity to recharge the batteries of the mobile communication means, in which case the user will want to retain the battery capacity for as long as possible. In an optimal situation, in a good receiving area, the current consumption is at its lowest while the quality of the link is at its best. The system according to this invention also detects faults occurring in the antenna, since deficiency in the antenna increases the ratio of reflected power to outgoing power. With the aid of the system according to the invention the user may also reduce to a minimum the SAR value and the quantity of radiation directed at his head or body by employing the correct appliance positions and situations and by adjusting the transmission time.

The system according to this invention is easy to incorporate in current mobile communication means, since for implementation of the invention use may be made of a directional coupler and transmitted power detector which are usually already present in current mobile communication means, so that only a detector of reflected power needs to be added to the mobile communication means. In a typical mobile communication means there are also a keypad and a display, which

means that the control functions of the system according to this invention may be performed programmatically making use of the microprocessor of the mobile communication means.

## Claims

1. A radio power monitoring system for a mobile communication means, **characterized** in that it comprises

- a detector (8) of power fed to the antenna,
- a detector (10) of reflected power returning from the antenna,
- a control device (26),
- at least one alarm device (28, 30, 32, 34)

and by the fact that the system is designed to monitor

- radio power fed to the mobile communication means antenna, and
- reflected radio power returning from the mobile communication means antenna, and by the fact that the system is designed to alarm the user of the mobile communication means of a manner of usage in which the radio power consumption of the mobile communication means exceeds a preset limit.

2. A system in accordance with Claim 1, **characterized** in that the said control device (26) is arranged to warn the mobile communication means user by at least one alarm device (28, 30, 32, 34) if the power fed to the antenna exceeds a first preset limit.

3. A system in accordance with Claim 1, **characterized** in that the said control device (26) is arranged to warn the mobile communication means user by at least one alarm device (28, 30, 32, 34) if the reflected power returning from the antenna exceeds a second preset limit.

4. A system in accordance with Claim 1, **characterized** in that it comprises at least one signal processing device (20, 22, 24) connected between the detector (8) of power fed to the antenna and the control device (26), and at least one signal processing device (20, 22, 24) connected between the detector (10) of reflected power returning from the antenna and the control device (26).

5. A system in accordance with Claim 1, **characterized** in that at least one signal processing device (20, 22, 24) is arranged to monitor the output signal of the detector (8) of power fed to the antenna, and at least one signal processing device (20, 22, 24) is

arranged to monitor the output signal of the detector (10) of reflected power returning from the antenna; and by the fact that the said signal processing devices (20, 22, 24) are realized as programmes of the control device (26).

6. A system in accordance with Claim 4 or 5, **characterized** in that at least one of the said signal processing devices (20, 22, 24) is arranged to calculate the average value for a predetermined period of the output signal of any said detector (8, 10). 10
7. A system in accordance with Claim 4 or 5, **characterized** in that at least one of the said signal processing devices (20, 22, 24) is arranged to calculate essentially the cumulative sum of the output signal of any said detector (8, 10) starting from the beginning of a call. 15
8. A system in accordance with Claim 4 or 5, **characterized** in that at least one of the said signal processing devices (20, 22, 24) is arranged to monitor the peak value of the output signal of any said detector (8, 10) occurring during a predetermined period. 20 25
9. A system in accordance with Claim 6, 7 or 8, **characterized** in that the control device (26) is arranged to monitor the output signal of the said signal processing devices (20, 22, 24) and to warn the user by means of at least one alarm device (28, 30, 32, 34) if any of the said output signals exceeds a corresponding preset limit. 30
10. A system in accordance with any preceding Claim, **characterized** in that it also comprises means (28, 36) for adjustment of the said limits. 35
11. A system in accordance with Claim 6, 7 or 8, **characterized** in that the control device (26) is arranged to present the user with the value of any said power quantity essentially on a continuous basis. 40
12. A system in accordance with any preceding Claim, **characterized** in that it also comprises means (28, 36) for selection of the method of alarming and for prevention of alarming. 45
13. A system in accordance with any preceding Claim, **characterized** in that the alarm signal generated by at least one said alarm device (32) is an acoustic signal. 50
14. A system in accordance with any preceding Claim, **characterized** in that at least one said alarm device (28) is the display (28) of the mobile communication means. 55

15. A system in accordance with any preceding Claim, **characterized** in that at least one said alarm device (34) is the vibratory alarm (34) of the mobile communication means.

16. A system in accordance with any preceding Claim, **characterized** in that at least one said alarm device (30) is a light-emitting diode (30).

17. A system in accordance with Claim 6, 7 or 8, **characterized** in that the control device (26) is arranged to monitor the output signal of the said signal processing devices (20, 22, 24) and to reduce the radio power fed to the mobile communication means antenna if any of the said output signals exceeds a corresponding preset limit.

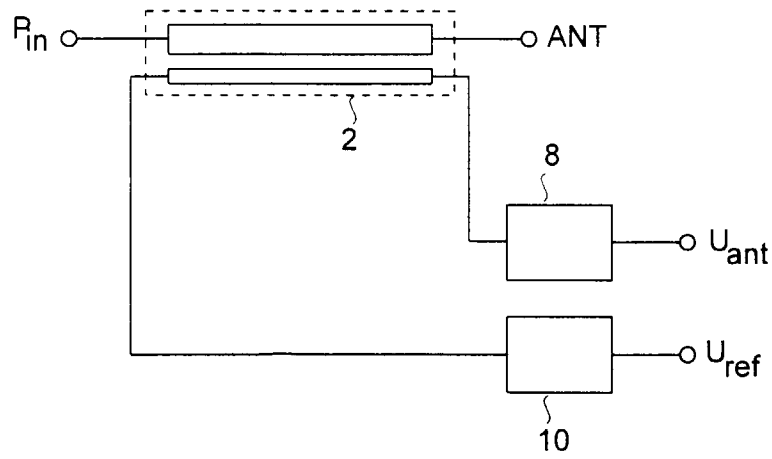


Fig. 1

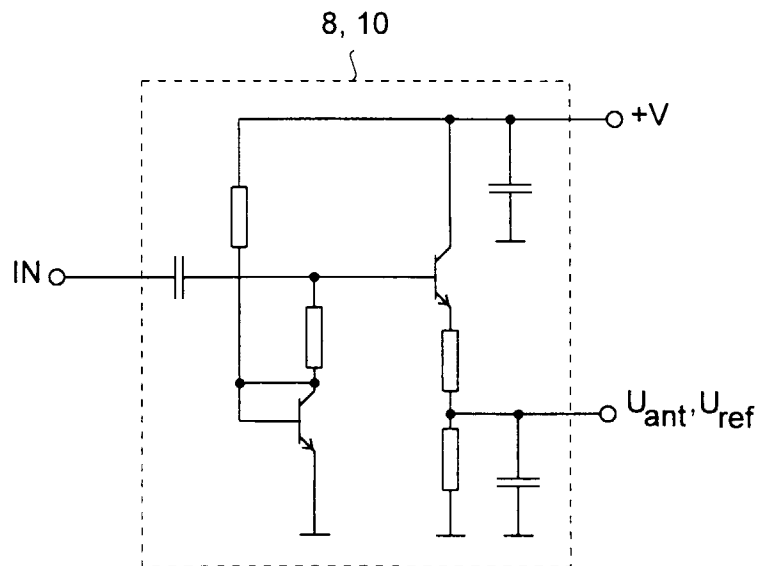


Fig. 2

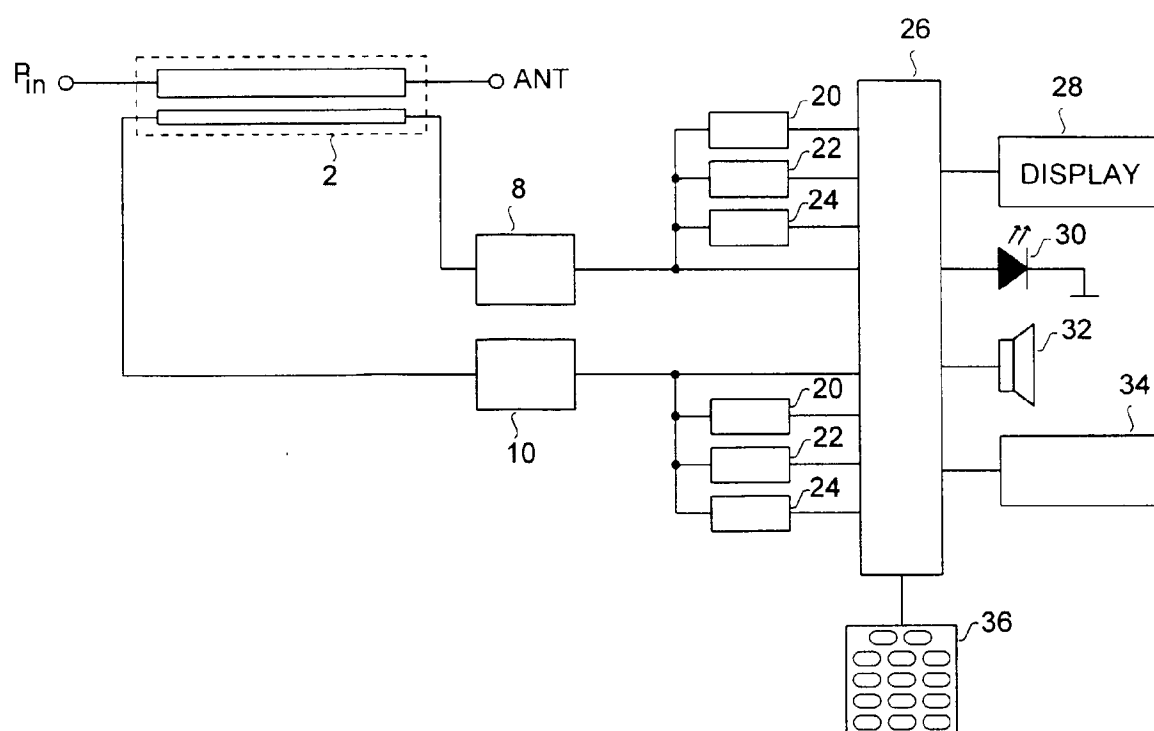


Fig. 3